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THE FOUNDERS, THE MOLDERS, AND THE MOLDING MACHINE

SUMMARY

The production of castings recently changed from primitive methods by the introduction of molding machines, 278. — Skilled journeymen at first indifferent, 281. — Laborers were used for operation of the machines, 283. — Subsequent change in policy of Molders' Union, 286. — Skilled men on the machines not successful, 287. — The Union and the National Founders' Association unable to make satisfactory terms, 290. — After cessation of negotiations Founders continued to introduce unskilled labor with success, 297. — The Union modified its membership policy to take care of unskilled workmen, 304.

THE manufactures of iron fall into three general classes: cast iron, wrought iron, and steel. The present paper deals with some recent problems connected with the manufacture of cast iron.[1]

Castings are made by preparing a pattern of the object, usually of wood, and imbedding this in a matrix of sand or loam of such a composition as will retain the shape into which it is pressed. The mold thus formed is made in two or more parts, later clamped together, with only a small hole or gate through which the metal, reduced to a fluid state in the furnace or cupola, is poured. When cool, the casting is shaken out from the sand, is cleaned, and is then ready for whatever finishing processes are needed. The general industry of casting metal is called founding, the workers are molders, the proprieters of the shops are founders or foundrymen, and the shops themselves are foundries.

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[1] The expansion of the automobile industry in the last few years has brought a great demand for brass and aluminum castings. Steel castings are a still more recent development in the trade. The census includes these in its classification of foundry and machine shop products; the National Founders' Association is open to foundrymen in all branches of the industry and the Union claims jurisdiction over all molders. The present study, therefore, deals in reality with the entire field of molding. Altho the Union in 1907 changed its name from Iron Molders' to International Molders', the former title will be retained in the present discussion.

Sometimes foundries are adjunct to factories, and make only the castings needed for the finished products of the machine shop. Sometimes they are not connected with any other establishments, but do a general machinery and jobbing business independently or on contract from concerns which have no foundries of their own. Sometimes they are large or small specialty shops turning out standardized products ready for the market. Sometimes they combine all three of the features just described. Foundry and machine shop products are classed together in the census. They are for the most part mutually dependent, however, hence the data there presented are significant as indicating in a way, the importance of founding. In 1909, foundry and machine shop products were the second most important manufacturing industry in the United States, in both the number of wage earners employed and in the value of the finished goods. Not including such distinctive articles as cash registers, calculating machines, sewing machines, electrical machinery, etc., there were 531,011 wage earners and the products were valued at $1,228,475,000.[1] July 1, 1912, 4,949 foundries were reported in the United States making steel, gray iron and malleable castings. If brass and aluminum castings are added, the total in 1912 was 5,996.[2]

The technical development of few industries was so long retarded as was founding. For many years, manufacturers were content with a shed and the most primitive implements. The main essential in the production of castings was thought to be a group of skilled artisans.

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[1] Thirteenth Census of the United States, 1910. Abstract, pp. 440–442.

[2] The Foundry, vol. xl (August, 1912), pp. 329, 330.

The molder was supreme. He was supposed to be coremaker,[1] molder and cupola tender all in one. He cut over his own sand, shook out and cleaned his own castings, and had very little to work with except iron, fuel, sand and a few simple tools. Tho rough and dirty, molding was a highly skilled trade requiring considerable technical proficiency, and in which the processes, many of them apparently simple, demanded long training and experience. A man had to know how to treat his sand so as to get a mixture just suitable for withstanding the heat and force of the molten metal. He had to set the cores accurately and ram the sand around the pattern so as to get a true and substantial matrix. Drawing the pattern so as not to break the mold was a very delicate process and any resulting imperfection had to be carefully patched. The mold had to be properly vented to allow for the escape of gas arising when the metal was poured. The iron, melted to white heat in the cupola, was poured by the molder who carried his own ladle from furnace to mold. In the process, if the mold was not properly made, an explosion might occur or pieces of sand might break loose and run in with the iron, or the metal might not flow freely and evenly, thus leaving unjoined portions; or it might shrink internally, causing holes and spongy places. In any of these circumstances, the casting was imperfect; his time and the material had been wasted.

True, even at this time all foundry work did not demand the same degree of skill. The making of small and light flasks on the bench has always required less of the molder than patterns so large and complicated as to necessitate their being bedded directly in a pit of sand or loam in the floor. Floor molding, especially if the design is worked out in loam with a sweep, requires the highest skill in the trade, and is, because of the position of the worker, arduous besides. Bench molders, on the other hand, making the smaller patterns, turn out in a given time, a larger number of castings. Machinery and jobbing work usually takes the best mechanics in the trade. Specialty work, of which there are some fifty varieties,[1] is to a large extent repetitive, and demands a varying range of ability.

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[1] Cores are made of sand and placed in the molds to form interior openings or holes in the castings when the pattern itself does not allow for these. Molding and coremaking, tho closely related, have long been considered by the workmen to be separate trades.

The first attempts to substitute mechanical devices for the molder's skill were crude and attracted little attention. But the inventors persevered and when finally the time came that molders were not to be had except at wages beyond the average employer's reach if at all, and then on terms he found distasteful, the producers of foundry machinery were ready to equip his shop with all sorts of appliances intended to relieve him of his dependence on human labor. The result is a foundry differing in many respects from that just described.

Not without a struggle has this change been brought about. Indeed, scores of foundries can still be found in which primitive methods prevail, or in which only a slight advance has been made.[2] This, however, is not peculiar to founding. Nor is it peculiar that one of the most difficult problems developed in the march of progress has arisen from the attitude of the workers in the industry. It is natural for those long trained to a skilled trade to be apprehensive of the rapid and unrestrained introduction of those forces which they fear will eventually take it away from them. So it has been in the foundries. As one mechanical improvement after another has come, and the molders have seen that their skill was becoming of ever lessening importance to their employers, they have tried to ward off disaster in such ways and by such means as have seemed at the time expedient.

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[1] T. D. West, quoted in Iron Molders' Journal, 1911, p. 270; ibid., 1913, pp. 19, 42.

[2] The Committee on foundry methods of the National Founders' Association estimated in 1916 that not more than 25 per cent of the foundries of North America have taken advantage of the available mechanical appliances. N. F. A. Service Bulletin No. 1, Chicago, 1916, p. 3.

The Iron Molders' Union has naturally taken the lead in protecting the workers' interests. This organization, numbering in recent years perhaps fifty thousand members[1] is one of the oldest of the existing trade unions, and is known to be one of the best managed, most effectively officered and adequately financed. Its local branches, of which there are several hundred, decide upon its national rules and elect its national officers. A general policy once formulated, uniform dues and benefits once established through convention vote or referendum, it is the national officers' duty to see that the law is carried out.

In 1899 the Union made an agreement with the National Founders' Association,[2] composed of about five hundred of the more important employers in the industry, to arbitrate disputes and thus do away with the evil effects of strikes and lockouts. It was the expectation of each organization that a set of mutually acceptable working rules would soon be evolved which would standardize conditions in the trade, and make it possible to legislate annually at one conference on all matters related to wages and shop practice. These standard rules were never adopted, however, largely because of the fundamental and unalterable difference of opinion between the two sides as to the introduction and operation of machinery and the development of specialized processes.

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[1] Membership of the Iron Molders' Union is very difficult to estimate because of its fluctuation in response to the ebb and flow of industrial prosperity. The organization itself no longer makes public its exact numbers. Since 1907 it has been represented in the American Federation of Labor on the basis of a membership of approximately 50,000, of which about 47,000 are in the United States. This is a little more than one-third of all the persons in the trade over which it claims jurisdiction. Leo Wolman, " The Extent of Labor Organizations in the United States," in Quarterly Journal of Economics, vol. xxx (May, 1916), pp. 488, 489, 619. In February, 1917, the editor of the Journal made some calculations on the basis of a 50,000 membership. Journal, 1917, p. 93.

[2] See also article by the writer, entitled " The National Founders' Association " in Quarterly Journal of Economics, vol. xxx (February, 1916), pp. 352–386.

Mechanical devices had been introduced in the foundries long before the Iron Molders' Union and the National Founders' Association adopted their arbitration agreement. Some of them, such as the squeezer, a simple appliance for packing thes and, and .the stripping plate for helping to withdraw the pattern without breaking the mold, were hand tools which for years the molders had used as a part of their regular equipment with no idea that either of them constituted a special kind of machine over which there should be jurisdictional disputes.[1] How unimportant machines were prior to 1890 is clearly shown by the small number of pages devoted to descriptions of them in the various manuals of molding published before that time.

About 1890 the first Tabor machine, designed to ram the sand by a method far superior to anything then in use, and operated by power, was put on the market. This was followed by machines which drew the patterns, then by others which combined the ramming and pattern drawing. Some of the power machines were profitable only when hundreds of castings from the same pattern were to be made, but others could be used to advantage for a lesser number, and many were adapted to fairly complicated work. Bright young laborers who had never been trained in hand molding began to operate the simpler types of machines, advancing gradually until even the most difficult patterns were made under their supervision. The brains which formerly had vested in the molder were transferred entirely, through the efforts of engineer and pattern maker, to the machine.

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[1] Bolland, loc. cit., p. 147; N. E. Spretson, " A Practical Treatise on Casting and Founding," p. 234; E. Treiber, " Foundry Machinery," translated and revised from the German by Charles Salter, p. 25.

The heartiest coöperation was met with from the men who were thus given an opportunity to better themselves. They were more than satisfied. If day rates were paid, their wages exceeded those of helpers and gangway men. On piece work, the almost universal method of paying for molds made on the machines, they could double the earnings they had received at their former employment. In addition, they enjoyed a quite definite psychic income accruing from the fact that they were now mechanics, makers of castings instead of mere common laborers. They were strong, they were used to hard work, and operating the machines was no more arduous than the tasks to which they had been accustomed.

It must be understood that molding machines, instead of being labor saving devices in the sense that they made easier the work of the molder, often necessitated a material increase in effort by the man who operated them. Tho time was actually saved in making any one mold, the fact that more molds were produced meant that there was more sand to shovel, there were more molds to lift, more molds to pour, more castings to shake out. That is to say, if a man without a machine turned out six castings, but thirty with it, he had to perform all the preliminary labor necessary to making twenty-four additional molds, and by just that much was the other labor incidental to the molding process increased.[1] If these extra operations were performed by laborers and machinery, as has more recently been the case, the molding machine operator became himself a mere machine, with none of the variety to his work which characterized the skilled hand worker.

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[1] A typical case is that of a certain job made on the bench and paid for at the rate of seven cents per flask. Sixty molds, necessitating ten ladles of iron, paid $4.20. Put on the machine, the price was set at two and three-fourths cents per flask, which would

The few foundrymen who experimented with the machines were delighted with the results. Their labor cost was reduced because of the use of laborers at wages far less than those paid to journeymen, and output was enormously increased. In addition, machine drawn castings were found to be more uniformly true to pattern, which meant less grinding and machine shop work, and therefore easier and less expensive finishing. Machine used patterns showed less wear and tear than patterns used on floor or bench. And, probably more important than any other consideration to the employer, the installation of molding machines lessened his dependence on journeymen mechanics. Machines having been invested in, the working force in a foundry could be changed with but little inconvenience, for the skill required for molding was still present in the wood and metal of the machines, while new operators were easily broken in.

Curiously enough, the molders paid almost no attention to the machines during the early stages of their introduction into the foundries. They seem to have been entirely indifferent, as if nothing had occurred that affected their trade or their interests. So firmly convinced were they that no harm could come to them through the introduction of machinery, as had been the case with numerous other trades, that they scorned all offers of an opportunity to operate it. They believed

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mean for the same daily pay, one hundred and sixty-five flasks to mold and twenty-eight ladles of iron to carry, together with one hundred and sixty-five flasks to shake out. The Journal characterized this as " enough labor to put any man out of business." Journal, 1907, p. 215.

molding would always require manual dexterity and the use of human intelligence and reasoning power. It could not be reduced to terms of a machine.[1]

Yet the use of molding machines steadily increased. By 1900 nearly 10 per cent of the total molding force employed by the National Founders' Association were machine operators, despite the fact that 62 per cent of the work made in its members' foundries was general foundry work, engines and machine tools, which branches are the least adapted to machine molding.[2]

The officers of the Union by this time had come to look facts squarely in the face. They saw their trade slowly slipping into the hands of laborers. They saw perfect castings being produced without the expenditure of any particular skill upon them. And they decided that the Union's policy in this matter must be changed, that the original attitude of scorn and ridicule had been a grave mistake, short sighted and unprofitable. It had not prevented the introduction of machines; machines were turning out molds; and if the Union did not now control them, the machines would soon displace the molders.[3]

Their problem was the twofold one of guarding against future danger and of repairing the damage which had already been done. So strongly was this situation emphasized by the Union's officers at the 1899 convention, that a report with the following recommendations was endorsed unanimously: *first,* that the future policy of the Union should be to seek to establish jurisdiction over the molding machine operator and all those who work in the various subdivisions of the trade of molding; *second,* that they advise and instruct their members to accept jobs on molding machines and to endeavor to bring out their best possibilities; *third,* that the officers of the organization ask the coöperation of the foundrymen in forwarding the plan, and in other ways seek to devise means of putting the new policy into effect.[1]

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[1] E. g., Journal, 1896, p. 65. William H. Sylvis, the first president of the Union, in trying to impress upon his constituency the desirability of making the trade an honored occupation through maintaining standards of skill, said " our trade is only in its infancy in this country and it is one of those trades that can never be interfered with by machinery for the reason that it requires a *thinking machine* to make castings." Proceedings, Iron Molders' Union, 1866, p. 12.

[2] Data furnished by the secretary of the Association from the reports of members for the last quarter of 1900. This estimate does not include coremakers. See also Quarterly Journal of Economics, vol. xxx (February, 1916), pp. 370, 381.

[3] President's address to the convention of the Iron Molders' Union, 1899. Proceedings, I. M. U., 1899, pp. 10, 11; Journal, 1899, pp. 395–397. See also frequent discussion of the subject in subsequent numbers of the Journal, and Proceedings, I. M. U., 1907, pp. 9 ff.

This complete change of front was made by a representative convention of the Iron Molders' Union, but in attempting to carry it out there developed a very difficult situation. The habit of indifference had been too long ingrained in the rank and file. They refused to operate the machines, and bitterly opposed the change.[2] Foundrymen, on their part, had become accustomed to laborers at the machines, found them entirely satisfactory, and were loath to allow the molders an opportunity to demonstrate their own superiority. But when these obstacles had been overcome and the members of the Union finally took their places at the machines, unsatisfactory results almost always followed. The output was not nearly as great as the employer thought it should be; the machines manifested a persistent tendency to get out of order. The journeymen after a few days' trial were always wanting to return to hand work. In addition, they expected to receive the pay which had been theirs as hand molders. The upshot of the matter usually was, that after thousands of dollars had been invested in machines, in a few weeks they were relegated to the shed or the yard and no more attempts were made in that particular foundry to carry on machine molding.[1] Or, if the employer persisted in his use of the machines, and returned to laborers as operators, they were promptly taken into the Union and the Union proceeded to help them secure "a wage commensurate with their output and skill."[2]

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[1] Proceedings, I. M. U., 1899, pp. 75, 101, 112, 165, 166; Journal, 1899, p. 397.

[2] E. g., letter in the Journal, 1899, pp. 412, 413.

There is no doubt that many skilled molders, put to work on the machines, did not honestly try to bring out their best possibilities. On the other hand, even when they did, results were not satisfactory. For instance, one foundryman reported that he had five molding machines operated by molders and two by laborers, and in each case the class of work was identical. The molders on their machines turned out from seventy-five to one hundred molds a day; the laborers made from one hundred and seventy-five to two hundred.[3] Another employer had sixty-seven machines. On sixty-two, small work was made and laborers were entirely satisfactory. On the five machines making the larger molds, they lost about 50 per cent of the castings and could not seem to get the knack of the process. When journeymen were put on, there was no loss from imperfect work, and furthermore, the output was increased. It was distinctly understood, however, that the molders were to leave the smaller machines entirely alone.[4]

There are several obvious reasons for the employers' lack of satisfaction with journeymen on the machines. In the first place, the position of the Union was that its members as well as the manufacturers should benefit by whatever improvements were introduced. Thus, if payment was by the piece, the same rate should prevail for machine as for hand molded castings. Or, if the day rate method was used, as the Union at that time greatly preferred, there was, it was thought no justification for the employer's insistence upon a lower wage rate because the molding was now done on machines instead of by hand. No reason has ever appeared to the Union why its members should work harder or receive a lower proportional rate on the machines than at hand molding.[1] The value of the machines to the manufacturer is largely determined by the amount of labor and skill they eliminate from the molding process.

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[1] Journal, 1903, pp. 11–14. See also United States Commission on Industrial Relations, Hearings at Washington, D. C., Tuesday, April 7, 1914 (MS.), vol. i, p. 256; vol. ii, pp. 581–588, 615.

[2] Proceedings, I. M. U., 1902, p. 617.

[3] Report of the Officers, N. F. A., November, 1902, p. 50.

[4] Proceedings, N. F. A., November, 1901 (MS.), pp. 93–100.

Again, skilled molders had not been trained to the heavier work made necessary by the machines; their apprenticeship had been served to brain and not to brawn. It was inevitable that their output should be inferior to that of men whose work on the machines was easier than that to which they had been accustomed; who, far from having any prejudice against it, since they had never known any other method of molding, were enthusiastic over its use, and felt their best interest to be akin to that of their employers in getting the most out of the machines.[2]

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[1] Hearings (MS.), vol. i, p. 314.

[2] "The reasons for the journeyman molder not to produce a maximum output on the machine are two: first, Union affiliation undoubtedly has created in the mind a dislike for and prejudice against the machines; second, he lacks a positive incentive to operate the machines to the best advantage. He anticipates no increase in his earning power — the reward is negative. The laborer is promised a large increase in his earning capacity if he gets the most out of the machine — the journeyman molder is promised employment at a less remunerative work or no work at all if he does not operate the machine to its full capacity.

"For the reasons stated above, it is doubtful whether a non-union journeyman would make a better success as a machine operator than a union journeyman. The fundamental problem is one dealing with human nature perhaps as much as with union labor. Any journeyman has through long years become so accustomed to certain fixed standards of a day's work that he finds it difficult to adjust himself against all inclination and active prejudice to new standards of output largely exceeding the old. Inquiry

Journeymen had everything to lose by the introduction of machinery — their trade, their skill and their pay — with much harder work in the bargain. Indifference on the part of many developed into active opposition, as employers, trade papers, and molding machine manufacturers constantly set before them the possibility that in the near future the new inventions were so to supplant the skilled mechanics that they would soon be superfluous encumbrances in the foundries.

At first, foundrymen were willing to let union molders take a turn at the machines if they so desired. They never for a moment regarded it as the molder's right, however, and of course expected that a much larger output would result than had been possible under the old hand process. When they found that journeymen would never go on machines if there were hand work to be done, that there was very little if any increase in output, and that the same rate was demanded for machine as for hand molding, they ignored the Union entirely and went back to the system of freely employing unskilled men on the machines.

Only a few months after the Union had voted to coöperate with the manufacturers in the introduction of machinery, tho after a long enough time had elapsed to demonstrate that the interests of employer and union employee were essentially divergent, the National Founders' Association adopted a resolution that they would use their own judgment as to who should operate the machines; that when it seemed skilled molders would do the best work as was sometimes the case, they

in non-union shops where both floor and machine molders are employed develops the fact that it is difficult, even thus when not encountering union prejudice against the machine, to get a man accustomed to floor or bench work to put up a full day's work on the machine." Stove Founders' National Defense Association. Report of the Committee on Machinery, 1908, pp. 13, 14. See also Proceedings, N. F. A., November, 1905, in The Review, December, 1905, p. 43; ibid., February, 1910, p. 6; United States Bureau of Labor, Bulletin No. 67 (November, 1906), "Conditions of Entrance to the Principal Trades," p. 714.

would be employed, but that the whole thing was a matter of shop practice quite outside the scope of any arbitration agreement, and that "molding machine operators should not be considered molders in any agreement entered into. . . ."[1]

It seems evident that whereas in the beginning the Association did not conceive of the Union's machine policy as one designed to limit output, a few months' experience caused a reversal of judgment.[2] Members believed they must be free to use the machines as they pleased; the high minimum wage demanded by journeymen, combined with their great scarcity during the period of business activity which characterized the years from 1899 to 1903, made necessary the introduction of whatever practices would make for less dependence on that class of labor.[3] Desirable members were being lost to the Association because they feared negotiation with the Union would deprive them of their prevailing or contemplated use of machines.[4]

It will be easily understood that the Association's arbitrary removal of the machine issue from the purview of their joint agreement, just after the Union had voted to enlist the Association's coöperation in working out a mutually acceptable policy, met with vigorous opposition from the Union. The first clash came at the now famous Detroit Conference of June, 1900. Said the National Founders' Association:

> Inasmuch as the molding machine is the product of the machine shop and not of the foundry, it is not under the jurisdiction of the molder, but having been produced at the expense of the employer, there shall be accorded to him the right to operate it in whatever

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[1] Proceedings, N. F. A., February, 1900, p. 35.

[2] Ibid., August, 1899; ibid., February, 1900, p. 39.

[3] Proceedings, Conference between the National Founders' Association and the Iron Molders' Union of North America, Detroit, October, 1902 (MS.), p. 14.

[4] Proceedings, N. F. A., February, 1900, p. 38.

> manner he may elect, the same as his right to operate his power plant, cranes or any other mechanical devices which have been brought into the foundry for the better prosecution of the employer's and molder's joint interest.[1]

The Molder's counter proposition was:

> That inasmuch as the molding machine is but an improved tool designed to increase and cheapen the product of the molder and represents both additional capital invested by the foundryman in his business, and a different method of applying and utilizing the capital (his labor) of the molder, we recognize that each is mutually interested in the manner of its operation.[2]

The Detroit conference ended in a deadlock and was soon followed by one of the most bitter strikes in the history of the industry. The settlement of this, after more than seven months of struggle, served only to confuse the machine issue. Among other things, it was stipulated:

> That the right of the foundryman to introduce or operate molding machines in his foundry shall not be questioned. In determining who shall operate them, regard should be given to the question of how their best possibilities can be brought out, and how the work can be most economically produced.[3]

But it was also agreed that in applying the principle of the minimum wage, " operators of molding machines who have not learned the general trade of molding " were not to be considered.[4] This was regarded by both officers and men of the Union as strictly in accord with the ruling of their recent convention, and as in no wise relinquishing their interest in the machine question.[5] Members of the Association, on their part, interpreted it as a surrender to their point of view and tried to use it as a precedent for introducing and operating machines at will, without consulting the Union at all.[1] As a result the Union became more seriously concerned than before over the machine issue, and found it necessary to repudiate on every occasion this statement of their machine policy.

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[1] Proceedings, Conference, Detroit, June, 1900 (MS.); Journal, 1900, pp. 384–387.

[2] Ibid.

[3] Proceedings, Conference, Cleveland, February, 1901 (MS.); Journal, 1901, pp. 133–135.

[4] Proceedings, Conference, Cleveland, February, 1901 (MS.); Journal, 1901, pp. 130, 131, 196, 197.

[5] Proceedings, Conference, Cleveland, June, 1901 (MS.); Journal, 1901, p. 403.

The Association's attempt to remove the molding machine issue from joint control with the Union was only slightly successful during the years 1899 to 1903. With business booming and a larger proportion of molders in the Union than ever before, employers had little choice as to their machine policy. While it is true that the national union showed no tendency to support a subordinate group in its opposition to the introduction of machines, help was frequently given when locals were trying to persuade foundrymen to allow their members to show what they could do. Some of the local contracts of the time are interesting as an indication of the expedients resorted to for the purpose of harmonizing conflicting opinions.

One way of getting around the difficulty was to call the unskilled non-union machine operators apprentices, even tho, because of the prevalence of a fixed ratio in some foundries, this necessarily reduced the number of legitimate learners of the trade.[2] In

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[1] Report of the President, N. F. A., May, 1901 (MS.), pp. 5, 6; Proceedings, N. F. A., May, 1901 (MS.), pp. 80–85, 91.

[2] An agreement signed in July, 1901 illustrates this:

"Whereas . . . it appears that this employment of a laborer on the molding machines has given rise to some irritation in the shop of the ——— Co., through a misunderstanding on the part of the molders, and also the further claim on the part of the Iron Molders' Union of North America that the question of the use of molding machines by inexpert labor had not been definitely settled between the National Founders' Association and the Iron Molders' Union of North America, at the solicitation of Mr. Valentine, first Vice-President of the Iron Molders' Union of North America, that the ——— Co. remove the machine or the laborer working thereon in order to allay any feeling that its use may have engendered in the shop of the company, the ——— Co. has consented to call the laborer engaged on the machine an apprentice, and to accept him as such, and under this name to operate the machine for the present. The ——— Co. agree to make another instance an arrangement was made whereby molders were to run machines with flasks more than twenty-four inches square or with an area exceeding 24″ x 24″, while laborers or unskilled molders were to work on machines with flasks less than that size.[1] Still others required that molders be given first choice as machine operators, and provided for joint determination of the piece or time rate.[2] All of these makeshifts were obviously unsatisfactory so long as no generally acceptable policy had been agreed upon. The persistent demands of the Union for a voice in the determination of a matter the Association considered beyond its power was a source of continual grievance to the latter; the Union was confessedly panicky over the fate of the trade.

In 1902, the national union, having failed to persuade the locals to help enthusiastically in the development of the machines by operating them fairly and bringing out their best possibilities as determined in the resolution of 1899; not entirely comprehending the Association's position in the matter, yet realizing that larger and larger groups of unskilled men were daily turning out satisfactory castings on the machines, resolved to extend the organization to these men. The experiment of forming a special local of machine operators had been tried in the autumn of 1901, and met with such success that their wages were raised and conditions generally were bettered. They were represented at the

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this change solely in the interest of peace, and under the special condition that none of their rights to operate molding machines in their foundries by inexpert labor or machine operators are thereby waived or relinquished or forfeited in any manner. And furthermore, it shall not be used as a precedent in any future conference or settlement of the question." Agreements with Foundrymen, 1901. I. M. U., Miscellaneous Records (MS.).

[1] Report of the Officers, N. F. A., November, 1902, p. 50.

[2] Agreement between Unions Nos. 19 and 24, and the Henry McShane Mfg. Co., December 31, 1902 (MS.); Agreement between the National Founders' Association of Pittsburg and the Iron Molders' Union of Pittsburg and Vicinity, no date (MS.); Agreement between the Gould Coupler Co., Depew, N. Y. and the Iron Molders' Conference Board of Buffalo and Vicinity, January 1, 1902 (MS.).

convention of 1902.[1] On the basis of this trial and because of the Union's urgent need to get control of the machine operators, who otherwise seemed in a fair way to walk off with the trade entirely, the 1902 convention amended the Union's admission requirements so as to include any molder who had served an apprenticeship of four years or worked at the trade four years "in any of its branches or subdivisions." [2] The executive board later decided not to grant an active card to machine operators until they had served their full time.[3] But even with this special membership, they were regarded as an integral part of the Union in every way.

From then on, the organization of machine operators progressed rapidly and made increasingly trying the relations between the Union and the Association. Each subsequent attempt to reach a uniform agreement on the machine matter — and there were many — only ended in a deadlock, for neither side receded from its original position in the least. Just as it appeared that the interests of the two organizations were so antagonistic as to make any reconciliation out of the question entirely, the industrial tide turned, the panic of 1903 was reflected almost at once in a lessened demand for molders and the Association lost no time in taking advantage of this situation to release themselves from a situation they had come to find intolerable. The arbitration agreement of 1899 was abrogated by the Association in 1904, and since then no negotiations whatever have been held between the two parties to the original contract.

From this brief account of the struggle of the Iron Molders' Union and the National Founders' Association over the introduction and operation of molding machines, it must appear that one fundamental issue, and only one, was involved on each side. There was, in the policy of the national union, no matter what the attitude of the rank and file, no hostility to the machines. Its officers were agreed with the National Founders' Association, that machines should be used. They were equally concerned to say when and under what circumstances. The Association was insistent in its support of those members who considered it their privilege to introduce machines at will. The Union was organized to protect its members in the sale of their labor, and this meant that they must control the ways in which the molding process was carried on. The Association, in order to enable its members to attain the greatest efficiency in their business, had to guarantee them its absolute control in their own hands. The two theories are so irreconcilable, it seems doubtful if any satisfactory permanent arrangement could ever have been reached, even with the complete coöperation of the local unions, which apparently was not given during the period in which attempts were being made to bring this about.

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[1] Proceedings, I. M. U., 1902, p. 617; Journal, 1902, p. 403.

[2] Proceedings, I. M. U., 1902, p. 754; Constitution, I. M. U., adopted 1902, Article VIII, Section 1; Journal, 1902, pp. 531, 532.

[3] Proceedings, I. M. U., 1907, p. 28.

One factor not generally understood is worthy of emphasis in this connection. Almost from the beginning of the industry, it has been the custom of the trade to recognize a " set day's work." When a pattern came into the shop, a few pieces were made from it and the foreman then fixed the time that normally would be required to make similar castings in the future. From then on, each man making pieces from that pattern was supposed to conform to the established " set." When the Iron Molders' Union came to be important in the foundries, the amount of the task or " set " became the subject of agreement between the shop committee and the foreman, but this was obviously only a formal recognition of what had always been a legitimate practice of the trade.[1] Thus, the hand worker had, through long years' practice, become accustomed to turn out so much and no more as a day's work. It is entirely possible, indeed quite likely, that journeymen trained to the hand trade and its speed, could never adapt themselves with entire satisfaction to the machine process; that for most of the molding machine work, unskilled men who had never had any other experience, who had no prejudices to live down or trade tricks to unlearn, would make the more successful machine operators.

After relations between the Iron Molders' Union and the National Founders' Association were broken off in 1904, members of the latter continued to use molding machines with entirely satisfactory results. Output was increased and thousands of dollars were annually saved to those who persisted in using and experimenting with the various types and combinations of appliances available.[2] Some of the achievements are interesting and suggestive. A report written in the spring of 1905, about a year after a very hard and bitter strike had been initiated in three large heater shops, notes the following: one foundry employing forty men at molding had only five journeymen; another had two journeymen out of twenty-eight; and the third had fifteen out of a molding force of one hundred and ten. All three firms were using molding machines and had contracted for the delivery of more. The operators were Poles and Italians, many of whom could not speak English and who had never worked at molding before. The day rate was \$1.50 to \$1.75. At piece prices, the method of paying about half the force, from \$2.00 to \$3.00 was paid, with more earning in the neighborhood of \$2.00 than \$3.00. While this was in excess of any pay the men had received before they took up molding, the saving to the manufacturer was considerable.[1] In these same foundries the average cost per ton for furnace molding had been \$20.50 before the strike; a year later it was \$16.25. When all the machines which had been contracted for were installed, it was expected the cost would be reduced to about \$14.00 per ton.[2]

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[1] United States Bureau of Labor. Eleventh Special Report of the Commissioner, 1904, " Regulation and Restriction of Output," pp. 149, 150; David A. McCabe, " The Standard Rate in American Trade Unions," p. 110; Proceedings, Conference, Detroit, October, 1902 (MS.), pp. 22, 74.

[2] The Review, October, 1905; Proceedings, N. F. A., November, 1905, in The Review, December, 1905, pp. 44, 46, 47; N. F. A., Plain Talk Pamphlets No. 2, p. 5.

This same report notes operations at a certain pipe foundry. One Pole was putting up sixteen molds per hour, size 16″ x 19″, from a pattern made for six pieces of one and one-half inch steam pipe fittings, requiring six cores in each mold. The man worked nine hours continuously at molding and netted one hundred and

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[1] The following table of rates compares prices paid before machines were introduced, and the machine molding price.

	Former price	*Subsequent price*
Base ring	\$0.36	\$0.25
Base ring	.55	.27
No. 36 upper deck	.34	.20
No. 40 upper deck	.42	.22
No. 44 upper deck	.60	.25
No. 36 lower deck	.37	.20
No. 40 lower deck	.47	.22
No. 44 lower deck	.66	.28
No. 36 upper fire-pot	.26½	.11
No. 40 upper fire-pot	.33½	.11
No. 36 lower fire-pot	.24	.11
No. 40 lower fire-pot	.29	.11
No. 36 shaking bar grate	.08½	.04½
No. 40 shaking bar grate	.09½	.04½
No. 40 short grates	.08	.04
Feed doors	.09½	.04½
Clean out doors	.05½	.02½
Clean out cellar	.06	.03
Water pan	.14½	.07
Water pan frame	.05½	.02½

Minutes of the Administrative Council, N. F. A., August 7, 1905 (MS.).

[2] Ibid.

fourty-four molds in that time. This represented eight hundred and sixty-four pieces of cored castings weighing eight hundred and seventy-five pounds. He was paid one and one-half cents per mold, or a daily wage of $2.16. Other men were said to be turning out forty-two pieces of soil pipe, five feet long and four inches inside diameter. The comment was that no living molder could put up over half of these jobs by ordinary molding methods.[1]

In addition to small and purely repetitive work, Association members have come to make heavy and intricate castings on molding machines. The patterns thus mounted may be changed from four to ten times a day.[2] With a proper adjustment of patterns and flasks, almost any mold can be made on some type of machine.[3] Indeed, the only limit seems to be imposed by the size of the machine itself.[4] The commissioner of the Association cites a number of instances of large and complicated molds handled in this way. A gas engine bed with a flask fourteen feet long, six feet wide and four feet deep, weighing with sand, pattern and board nearly 30,000 pounds, was made on a machine by one handyman and one helper in eighteen hours, where the previous method had taken the time of one molder and one helper for five days. The finished casting from this mold weighed 11,920 pounds and had the additional advantage of being 1,000 pounds lighter than it would have been had it been made according to the old method.[5]

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[1] Minutes of the Administrative Council, N. F. A., August 7, 1905, (MS.).

[2] Report of the Commissioner, N. F. A., November, 1908, in The Review, December, 1908, p. 33.

[3] Report of the Commissioner, N. F. A., November, 1910, in The Review, December, 1910, pp. 29, 30.

[4] Report of the Commissioner, N. F. A., November, 1911, in The Review, December, 1911, p. 28; The Review, January, 1910, p. 33.

[5] Ibid., September, 1909, pp. 11–13; ibid., January, 1910, p. 76.

Further examples might be produced to show the use of molding machines for this and similar work.[1] But it is important to note other items. In some cases no alteration whatever in the pattern is necessary in transferring from hand to machine molding; in others, machines can be used only because of the expert engineering skill that has gone into the making of the patterns.[2] For some castings, such for instance as heavy machinery, part of the molding work may be done on the machines and part by skilled molders on the floor or the bench.[3] Again, machines for molding some specialties have been made absolutely automatic. They require no human labor whatever save for setting the cores, pouring the metal and shaking out the castings.[4]

With adequate machinery, it takes but little time nowadays to transform a common laborer into a first class machine molder. At first, it is probable that a considerable amount of bad work was produced on the machines. For a long time the Union made a great deal of this point, and claimed that the discount for bad work often ran from 30 to 50 per cent.[5] With proper machines and instruction, however, it has been found that in from three to six weeks an employer can safely entrust much to a machine operator, and in a few months nothing a machine can handle is beyond the powers of the operators.[6]

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[1] See The Review, October, 1909, p. 29; ibid., January, 1910, pp. 29, 30. Many numbers of such papers as The Foundry, The Iron Trade Review, The Iron Age, contain articles describing the achievements of machines and mechanical devices of all sorts.

[2] The Review, October, 1909, p. 29; ibid., January, 1910, pp. 71, 79.

[3] Ibid., January, 1910, pp. 44 ff.

[4] See, for example, a description of the continuous process in making radiators, in The Foundry, vol. xl (January, 1912), pp. 1–5.

[5] Minutes of the Administrative Council, N. F. A., August 7, 1905 (MS.); Journal, 1907, and succeeding years.

[6] Probably the following account is typical.

". . . The best trick they have done so far is to jar a 24-inch cylinder. They reduced the molding time on this from seven to four days. You would be surprised to see

The advantages to foundrymen of introducing molding machines may be summarized, then, from their point of view, as freedom from dependence upon skilled labor, and especially from negotiations with the Union which had been characteristic of the trade when the labor of its members was an absolute necessity; more accurate molds and longer lived patterns;[1] lighter castings; an increased output varying from double to forty times the production under the hand system;[2] and a decreased cost of production amounting in some cases to 75 per cent.[3]

More progress was made in introducing efficiency methods and output increasing devices in the five years immediately following the break between the National Founders' Association and the Iron Molders' Union than in the twenty-five years preceding.[4] While a number of circumstances contributed to bring this about, undoubtedly the most important single factor was the prevalence of labor troubles and the activity of the Union.

The strikes of 1903 and 1904, instituted by the Union to resist the changes in wages and conditions which the foundrymen undertook to introduce the moment the industrial situation was favorable, resulted in a number of firms breaking away from collective agreements entirely. This they were enabled to do to some extent through the increased use of machines. But the greatest spur to trying out labor substitutes came in the

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green men handing 15-ton wheels and 33-inch beds. This bed plate under the old system, with the Union, was a six day job and under the new system they have just completed nine of them in twenty days. The first one cost them four days, and they cast one every two days thereafter." The Review, June, 1909, pp. 19, 20.

[1] Ibid., June, 1910, p. 33.

[2] Hearings (MS.), vol. i, pp. 255, 256.

[3] The Review, October, 1909, p. 29.

[4] Report of the Commissioner, N. F. A., November, 1909, in The Review, December, 1909, pp. 35, 36; Hearings (MS.), vol. ii, p. 619.

spring of 1906. During the previous two years the Union had been preparing for a general advance in wages, shorter hours and the like, and in May declared what threatened for a short time to be a general strike to bring this about. In many foundry centers it was impossible to secure molders except at the Union's terms. To meet this situation the Association called a special convention and determined to resist the demands, no matter what the cost. Hence foundrymen who up to this time had been indifferent to the molding machines or had refused to consider them, were forced to have them installed in order to get their orders out. A tremendous incentive was given to inventors also to produce machines which would take care of work hitherto considered to be exclusively the province of skilled men.

A circular sent to members of the Association June 23, 1906, estimated that nearly one thousand machines had been introduced since May first, and pointed out that increasing numbers of foundrymen were coming to realize their earning power when operated by intelligent men. The improvement in technique brought about in that crisis caused the president of the Association several years later to make the assertion that until the 1906 strike, the founding industry was at least fifty years behind the times.[1]

The National Founders' Association has encouraged the introduction and use of machines in every way. Special committees have been appointed to make investigations [2] and it is now the accepted policy of the Association when a member is having difficulties with the Union or complains of a shortage of labor, to study the particular shop in question and map out a plan for installing machines to take the skilled men's places.[1] Just what effect the war and its needs have had on the utilization of machines, is not subject to statistical measurement at this time. The 1917 convention of the Association devoted an entire session to the subject for the purpose of demonstrating to its members how many current problems might be solved by the introduction of mechanical equipment. Molding machine manufacturers are said to be overwhelmed with orders, and delivery cannot be made in less than six or eight months. It is to a certain extent true that "the molding machine and the handyman molder have made possible the open shop in the foundry." [2]

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[1] Proceedings, N. F. A., November, 1910, in The Review, December, 1910, p. 10.

[2] Minutes of the Administrative Council, N. F. A., November 19, 1908 (MS.). See also N. F. A. Service Bureau Bulletins.

Specialization has been developed to the highest possible degree. Trained designers make patterns so simple that a man with little experience can use them. Tool makers have coöperated to turn out machines for making castings which the molder of twenty years ago would have said only the most skilled mechanic could produce. Laborers and operatives trained not in the general trade of molding, but only in one simple branch, do work which it was thought belonged to the expert on the bench. Coremaking, which everywhere used to be regarded as a trade in itself, has also become somewhat of a machine process. The technique of cupola and ladle have been vastly improved. An overhead crane reaching into all parts of the shop, lifts patterns and molds and castings. Sand is cut, mixed and sifted, and castings are chipped and cleaned by machinery. In up-to-date foundries a mechanical engineer often has charge of the entire plant; a chemist tests iron and sand for each of the special uses to which they are to be put. Everywhere the development of the industry has meant increasing differentiation between the mental and the manual work, more intense simplification of processes, more minute specialization of tasks.[1] With this has come greater efficiency of management, a higher standard of safety, and better conditions generally for workmen, producers and the consuming public.

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[1] Report of the Commissioner, N. F. A., November, 1910, in The Review, December, 1910, p. 27.

[2] Ibid., p. 30.

It is not to be understood that this development of specialization and the use of machines has entirely eliminated the Iron Molders' Union from its very important place in American foundries. That the Union has retained its foothold is due to the tireless watchfulness of the organization's leaders, and their speedy adaptation of union law to meet the changing conditions. At the 1907 convention, additional steps were taken to get the machine operators into the organization. This came the year after their only partially successful general strike had shown how powerful a weapon the molding machines might be against them. The constitutional qualifications for membership were defined so as to include machine operators as such; they were to be granted a special charter in any community large enough to support a separate local,[2] and the officers were given great latitude in determining the method of compensation for work done on the machines.[3]

A definite campaign to organize the machine operators was undertaken forthwith. This plan under way, the Union believed its machine problem had been solved. But new issues continued to arise. Individual members insisted upon advocating the destruction of machines or handicapping their usefulness as much as possible;[1] proposals were made to do away with the special machine molders' cards, which would allow only men who had been at the trade four years to operate the machines.[2] The executive board has sanctioned a number of grievances of locals against the use of handymen on machines,[3] but has adhered firmly to the policy of organizing and bringing into the Union as many machine operators as possible.

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[1] Subdividing foundry work may be carried to such extremes as to produce facing mixers, mold rammers, pattern drawers, gate formers, feedinghead makers, mold closers, metal temperature judges, mold pourers, casting feeders, etc., etc., all knowing but the one thing which has been learned in a few weeks. Journal, 1913, p. 41.

[2] Proceedings, I. M. U., 1907, pp. 102, 103, 193; Constitution, adopted 1907, Article VIII, Section 6.

[3] Journal, 1907, p. 650.

In the foundries where the apprentice ratio of one to five journeymen prevails, the policy has been to allow machine operators who have served less than four years, only if the apprentice quota is not complete.[4] It is expected that in union shops all molding machines will be operated by union members or apprentices.[5] No member is permitted to teach or instruct a machine operator who does not belong to the Union or who is not an apprentice, under penalty of expulsion. A union foreman cannot work over a non-union machine operator unless the latter is an apprentice.[6]

The net result of the attempts to enforce in American foundries these machine policies of Union and Association, so essentially in conflict, would be hard to estimate. The following table based on figures furnished by the secretary of the National Founders' Association, shows the per cent machine operators were of the total molding force in the foundries of Association members at different periods:[7]

1900	9.4 per cent
1905	14.4 " "
1910	19.4 " "
1913	22.8 " "

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[1] Journal, 1909, p. 122.

[2] Proceedings, I. M. U., 1912, pp. 166, 243.

[3] Ibid., p. 51.

[4] Ibid., p. 222.

[5] Ibid., pp. 156, 206, 223, 238.

[6] Ibid., pp. 126, 127, 206; Constitution, adopted 1912, Article XIII, Section 8.

[7] See also Quarterly Journal of Economics, vol. xxx (February, 1916), p. 381.

In the same time, skilled bench and floor molders changed in relative importance to the total molding force as follows, constituting in

1900	75.7 per cent
1905	63.0 " "
1910	54.3 " "
1913	51.8 " "

Comparing these two groups, it appears that while molding machine operators have increased considerably in importance to the total molding force in Association foundries, skilled mechanics have been displaced at a more than proportionate rate. It thus would seem that machine operators alone cannot be charged with having driven journeymen from their accustomed trade. Of nearly as great importance in bringing this about has been the increase in the numbers of unskilled specialty molders. Data available do not permit of distinguishing this class of labor from apprentices in 1900, but the increase even from 1905 to 1913 is significant.

Per cent specialty molders were of the total molding force:

1905	9.5 per cent
1910	15.0 " "
1913	15.6 " "

These figures, taken in connection with the preceding groups must not, however, be used as conclusive evidence that unskilled workmen are usurping the places of journeymen in the foundries of members of the National Founders' Association, because of the fact that there is no way of measuring to how great an extent the class of foundries making up the membership of that body has changed, so as to offer a wider opportunity for the employment of laborers.[1] Nevertheless, from the facts available it seems likely that while skilled mechanics continue to occupy an important position in Association foundries, their place is gradually being taken by inferior craftsmen.

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[1] An increase in the number of members who made specialties as against those who made heavy machinery would mean a greater likelihood of the employment of machine operators and specialty molders. The reverse would be true if the increase in members came from the ranks of the heavy machinery makers.

How this tendency compares with conditions generally cannot be stated. In 1910, the National Founders' Association employed 13.4 per cent of all those in the country who worked at the trade of molding.[1] Eighty-five per cent of its members run open shops.[2] It is therefore possible that among those foundries where union influence has had more weight, skilled journeymen are of relatively greater importance than in the shops of the Association. Certainly up to 1908, the Union had succeeded admirably in controlling the machine situation in the shops of the Stove Founders' National Defense Association,[3] and as these two latter bodies never came to an agreement as to the pricing of work done on the machines until 1914, it is quite likely there has been but little change up to the present time.

The Union itself offers no data as to the relative importance within its membership of skilled mechanics, specialty molders and machine operators. Nor is there any satisfactory means of estimating the probable composition of its membership, at the present time as compared with twenty years ago. It seems very probable, however, on the basis of known facts, that even tho the numbers over a given period are substantially identical, a smaller and smaller proportion are skilled men.

This much is true: molding machines have made serious inroads upon the molders' trade; the employers of the country have come to realize the value of machines and are using them in ever increasing quantities; the Molders' Union has been obliged to alter its policy at a number of points to allow for the changed conditions. On the other hand, it is not true that machines have made human skill unnecessary for foundry work. There is still a great demand for trained men. Even with specialization and machine molding, experts are required to set cores, finish and close molds, and perform other similar operations demanding the application of technique and judgment. Some types of molding are as yet entirely unadapted to the machines.

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[1] On the basis of 18,411 molders and coremakers, exclusive of apprentices, employed by the National Founders' Association, and a total of 137,262 male molders, founders, casters and coremakers enumerated in the census of 1910, Thirteenth Census of the United States, 1910, vol. iv, Table VI.

[2] Hearings (MS.), vol. i, pp. 242–243, 245, 248, 251.

[3] Stove Founders' National Defense Association. Report of the Committee on Machinery, 1908.

To how great an extent the proportion of skilled men required will decrease in succeeding decades cannot possibly be determined. On this will hinge almost entirely the Union's structure and activities. And on this will depend to a large degree the future policy of the Association. If a steadily increasing proportion of the trade is given over to machines and unskilled foreign workmen whom it is difficult for the Union to organize and hold in the face of alluring offers from their employers, the Union is likely to suffer. If the maximum possibilities of the machines have already been realized, the Union stands a very fair chance of holding its own, no matter what the organized employers may do.

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